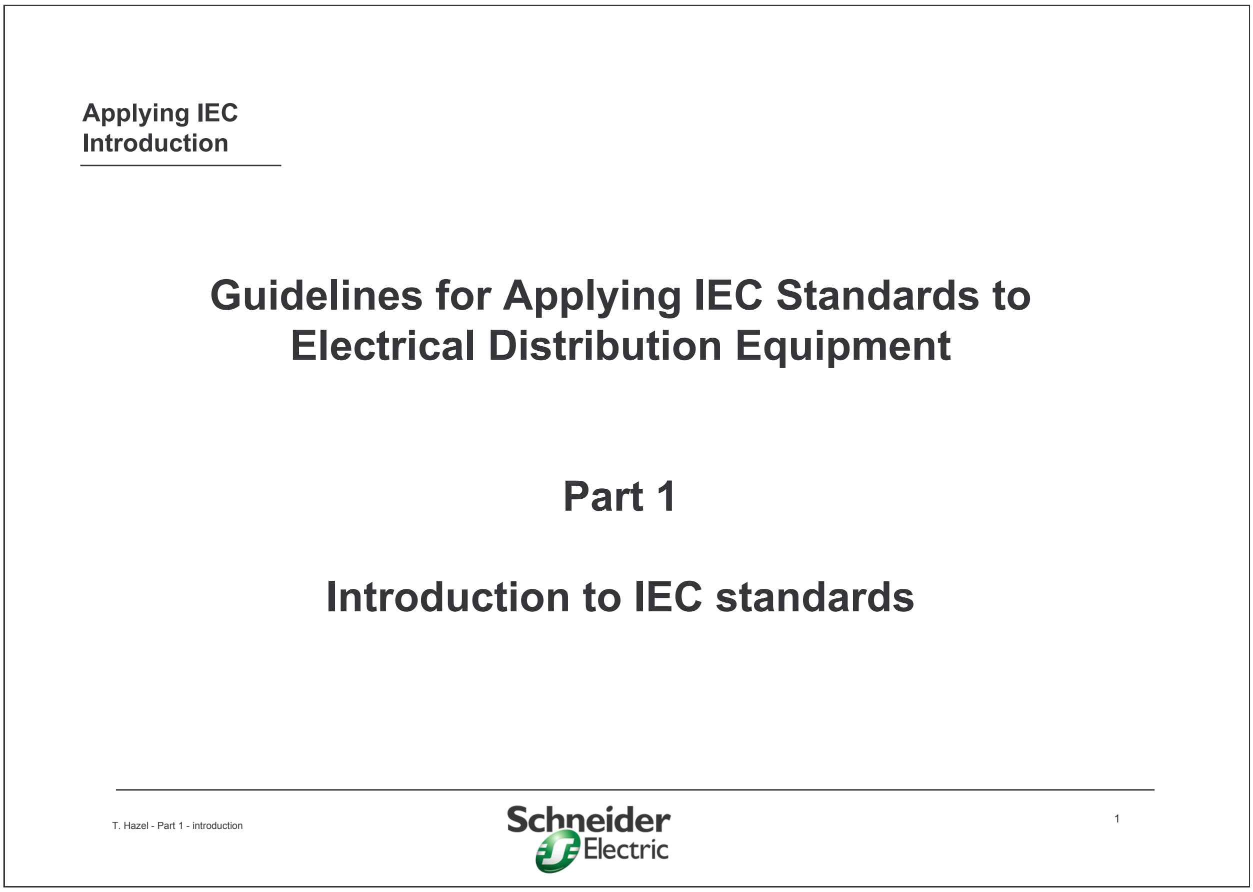


Guidelines for Applying IEC Standards to Electrical Distribution Equipment

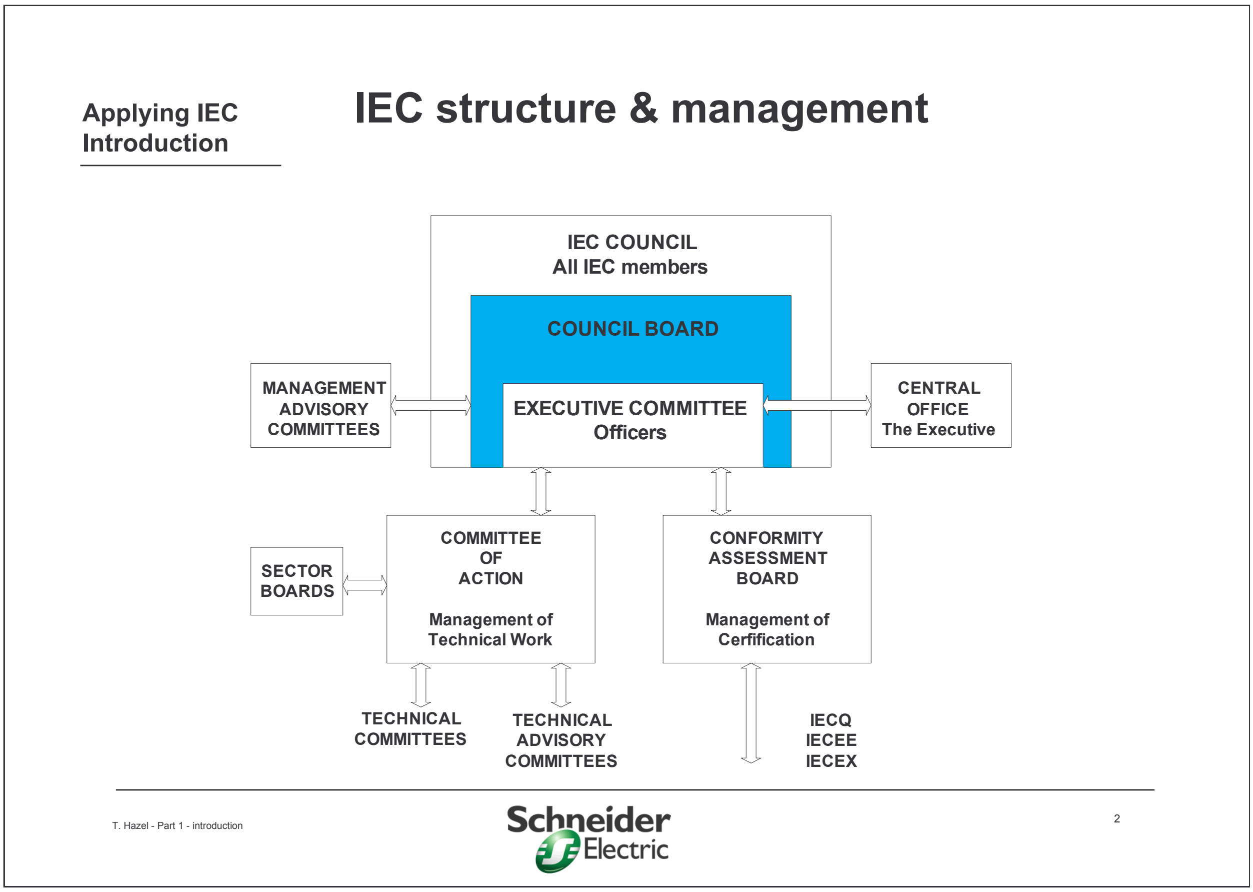
Part 1

Introduction to IEC standards

what are IEC standards?

The International Electrotechnical Commission (IEC) is the authoritative world-wide body recognized by the World Trade Organization as being responsible for developing international electrotechnical standards. More than 50 countries participate, including all the world's major trading nations. The members of the IEC are the National Committees, each having equal voting rights. Each National Committee agrees to ensure open access and balanced representation from all private and public electrotechnical interests in its country. The National Committees play a leading role in all decision-making instances ensuring the widest degree of consensus at an international level. It is their responsibility to implement the decisions of the IEC at the national level.

An IEC standard is therefore truly international. The standards themselves are normative documents which have been developed according to consensus procedures, and provide rules and guidelines for achieving the optimum degree of order in a given context. They are designed for common and repeated use and therefore cover the major parts of the fields of interest but not all parts. IEC standards can therefore be applied as such in 90 – 95% of all applications. For the remainder special agreement between the manufacturer and user is required to ensure that the equipment will meet the requirements of the application.



Applying IEC
Introduction

IEC structure & management

IEC COUNCIL
All IEC members

COUNCIL BOARD

EXECUTIVE COMMITTEE
Officers

MANAGEMENT
ADVISORY
COMMITTEES

CENTRAL
OFFICE
The Executive

SECTOR
BOARDS

COMMITTEE
OF
ACTION

Management of
Technical Work

CONFORMITY
ASSESSMENT
BOARD

Management of
Cerfification

TECHNICAL
COMMITTEES

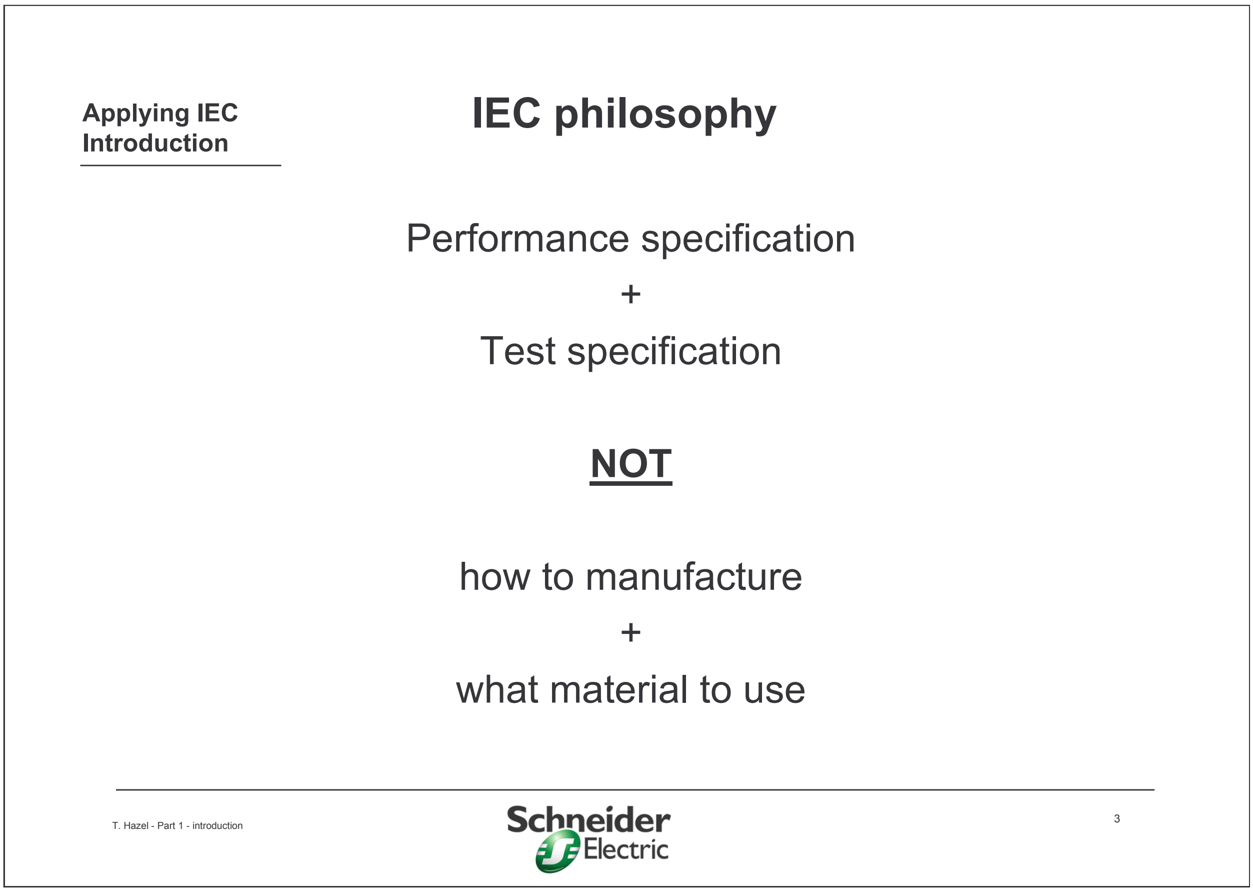
TECHNICAL
ADVISORY
COMMITTEES

IECQ
IECEE
IECEX

organization of the IEC

The IEC is chaired by a President who is elected for 3 years by a council made up of representatives of all member countries. There are also three Vice-Presidents, a Treasurer assisted by a financial committee, and a General Secretary. The latter is the head of the *Central Office* which has a permanent staff of about 100 people and is based in Geneva. This Central Office administers the IEC, publishes the standards, and sells them.

The responsibility for the technical work is the duty of the *Committee of Action* (CA), which reports directly to the Council. It coordinates the work of the various committees. It is assisted by *Advisory Committees* for some topics which are general to all activities. These include safety, electromagnetic compatibility (EMC), environment, and communications. Every year these committees hold a 2-week general meeting together with some Technical Committees according to their needs and to the interests of the National Committee hosting the meeting.



Applying IEC
Introduction

IEC philosophy

Performance specification
+
Test specification

NOT

how to manufacture
+
what material to use

main philosophy of IEC standards

The basis of IEC standards is to define performance requirements together with the testing required to demonstrate compliance of equipment. Section 5.2 of the Directives for the technical work makes the following statement:

> *performance approach: requirements shall be expressed in terms of performance rather than design or descriptive characteristics. This approach leaves maximum freedom for technical development. Requirements concerning the manufacturing process shall usually be omitted in favor of tests to be made on final product.*

IEC standards and the applications engineer

Applications engineers are often surprised when they first use IEC standards in a project. This is probably mainly due to the performance approach described above. Generally this philosophy will give more possibilities to manufacturers of equipment but makes application engineering more difficult. In some cases IEC standards will place more responsibility on the applications engineer than other standards systems. Some of these ideas are presented in the following comparison table.

advantages	disadvantages
Manufacturers have a large degree of freedom to innovate and to implement newest technology. Satisfying the performance requirements is all that is required.	The size and weight of equipment proposed by different manufacturers based on the same specification can be very different. This makes it difficult for applications engineers to make preliminary estimates of the required space at site for housing the equipment. The accessories required for the equipment and connections to other equipment can also be very different.
Manufacturers can use locally available components to optimize their design. The relative price of labor versus components can result in the same type of equipment manufactured by the same company being quite different depending on where the equipment was made. Sometimes it is not sufficient just to know the name of the manufacturer and the type of equipment in order to know what will be supplied.	Differences in existing national standards are sometimes difficult to eliminate with the result that certain points cannot be agreed upon. Either these points are not included in the IEC standard, or they are included in a very general way allowing wide interpretation. A national standard using the relevant IEC standard as a basis may have additional requirements to ensure implementation of the points which could not be accepted by the IEC. These additional requirements must normally be met.

Types of IEC standards

- **Basic (horizontal) standards**

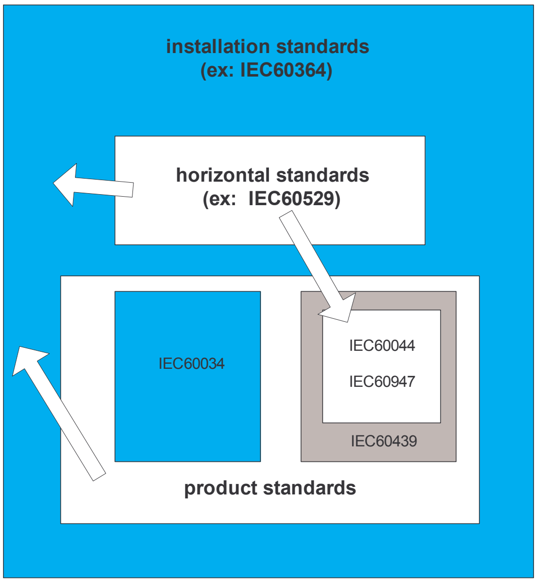
  apply to several products and installations

- **Product standards**

  apply to components and assemblies of components, like Russian dolls

- **Installation standards**

  apply to installations such as substations and buildings



installation standards
(ex: IEC60364)

horizontal standards
(ex: IEC60529)

IEC60034

IEC60044

IEC60947

IEC60439

product standards

different types of standards

There are three main types of standards

☐ basic standards

☐ product standards

☐ installation standards.

basic standards

These standards are general and deal with topics used by several other standards. They are also called *horizontal* standards. Their purpose is to avoid that different standards have different provisions for the same subject such as graphical symbols, degrees of protection for enclosures, mechanical or climatic tests, which would lead to incoherence and confusion in testing.

The following list of Technical Committees in charge of the main basic standards gives a good idea of the fields covered:

☐ TC1	terminology
☐ TC3	documentation and graphical symbols
☐ TC8	standard voltages, current ratings and frequencies
☐ TC10	fluids for electrotechnical applications

☐ TC16 basic and safety principles for man-machine interface, marking and identification

☐ TC25 quantities and units and their letter symbols

☐ TC28 insulation coordination

☐ TC42 high-voltage testing techniques

☐ TC56 dependability

☐ TC64 protection against electric shocks

☐ TC70 degrees of protection by enclosures

☐ TC74 safety and energy efficiency of information technology equipment

☐ TC77 electro magnetic compatibility (EMC)

☐ TC89 fire hazard testing

☐ TC104 environmental classification and testing.

When a topic is covered by a basic standard, product standards normally refer to it adding possible implementation criteria.

product standards

Products standards can also be split in categories enclosing each other like Russian dolls.

☐ material standard (oil, winding wires, magnetic alloys and steels...)

☐ component standard (electronic capacitors and resistors, insulators...)

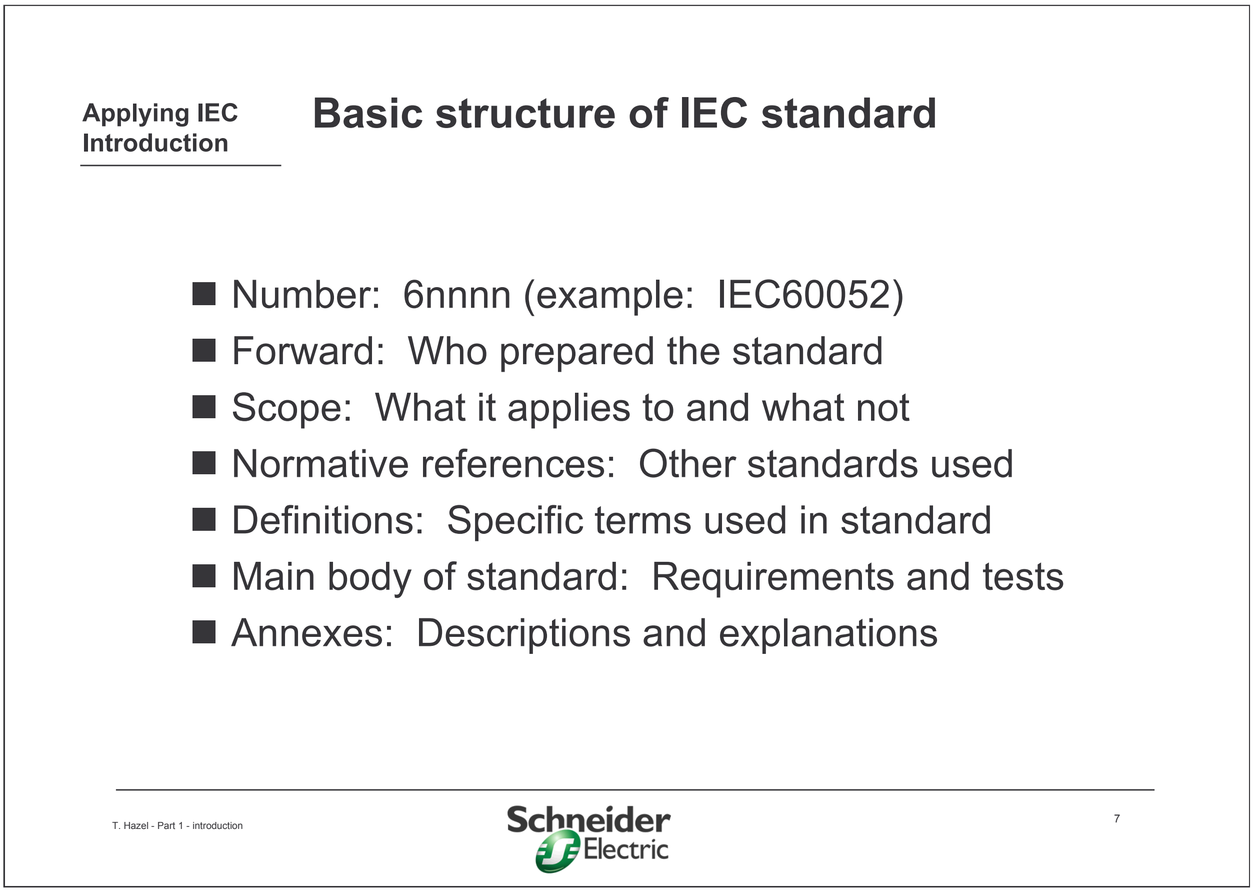
☐ individual product standard (transformer, surge arrestor, motor, circuit-breaker...)

☐ assembly standard (GIS, switchgear and controlgear, UPS...)

Each level normally refers to the previous level and adds additional information. Product standards often contain guidelines as to what information should be specified by the purchaser and by the manufacturer. This information is very useful and can help avoid incomplete specifications.

installation standards

Installation standards give information and rules to insure good operation and safety when various types of equipment are connected together for a specific application, as in mines, buildings, ships, and high-voltage substations.



Applying IEC
Introduction

Basic structure of IEC standard

- Number: 6nnnn (example: IEC60052)
- Forward: Who prepared the standard
- Scope: What it applies to and what not
- Normative references: Other standards used
- Definitions: Specific terms used in standard
- Main body of standard: Requirements and tests
- Annexes: Descriptions and explanations

typical organization of IEC standards

Since 1989 IEC and ISO standards are organized as follows.

divisions

A standard may be divided into several leaflets.

The text is divided into *clauses* with a simple distinct number. Very often clauses are sub-divided into *sub-clauses*. When the text is interrupted and jumps to the next line, it is called a *paragraph*. These terms are used to refer to particular parts of the text. When referring to the document itself the expression *this standard* is used

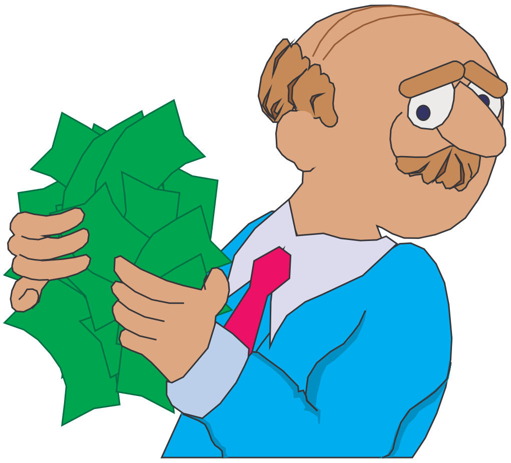
IEC standards are issued bilingual with the French text on the even pages and the English text on odd pages. Some pages in the standards are bilingual however (drawings, tables, etc.) and care should be taken when consulting a standard that all pages are available in the desired language. IEC60050 International Electrotechnical Vocabulary (IEV) gives the translation of terms and definitions in six to eight other languages including Russian, German, Spanish, Dutch, Polish, and Arabic.

www.iec.ch

Standards are constantly changing !

Consult the IEC web site for current information on

- reissues
- new standards
- standards cancelled and replaced by other standards
- new amendments

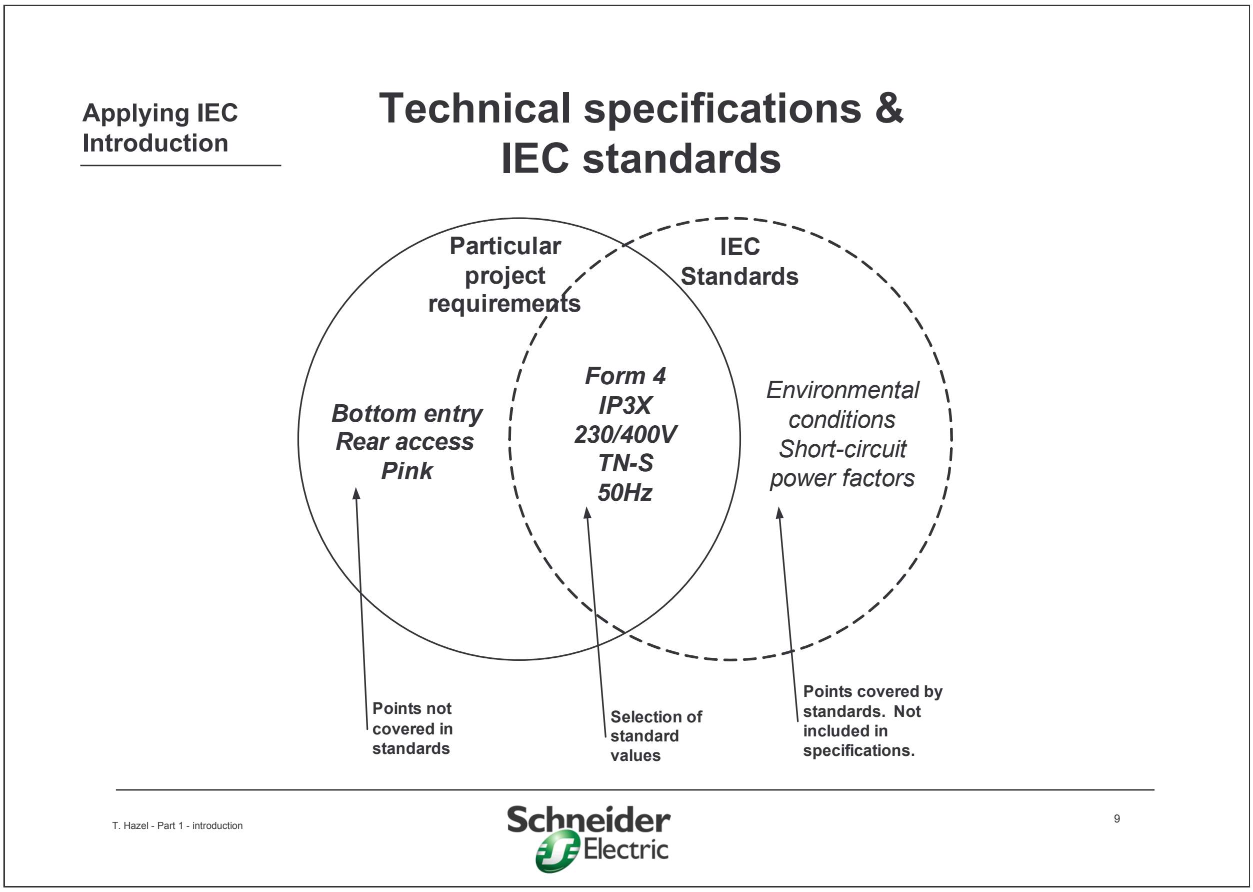


As seen previously, IEC standards are continuously being updated, including the number. The user should ensure that he has the latest revision of the applicable standards, and all amendments. The easiest way to do this is to consult the IEC web site www.iec.ch. The on-line catalog will give the date of the standard and any amendments to it, as well as indicating the work in progress. Cancelled standards are also shown in the on-line catalog.

useful IEC documents

In addition to the web site the following documents are useful.

- ☐ IEC catalog issued each year updated every 2 months
- ☐ IEC Yearbook which gives for details about each TC and SC
- ☐ IEC Directory which gives details of members, officers, NCs, and organization chart
- ☐ The IEC Dictionary
- ☐The IEC bulletin



Technical specifications & IEC standards

Particular project requirements
IEC Standards
Bottom entry
Rear access
Pink
Form 4
IP3X
230/400V
TN-S
50Hz
Environmental conditions
Short-circuit power factors
Points not covered in standards
Selection of standard values
Points covered by standards. Not included in specifications.

technical specifications

A *technical specification* is a document prepared by a purchaser to specify his requirements. Examples of such documents are end-users' specifications which are meant to harmonize the equipment purchased for different plants, and engineering company specifications reflecting common practice. The Preferred Industry Practices presented during the 1998 PCIC Conference is another example. These are important contractual documents but are not standards. Technical specifications normally refer to the applicable standards and include additional particular requirements.

Technical specifications should be written based on the following principles:

☐ Points already covered by referenced standards should not be repeated in specifications.

☐ Standard optional values defined in the standards should be selected based on project requirements.

☐ Additional information not covered in referenced standards is to be added to the technical specification.

Use of systems of standards

DO

Specify what you need based on 1 set of standards.

DO NOT

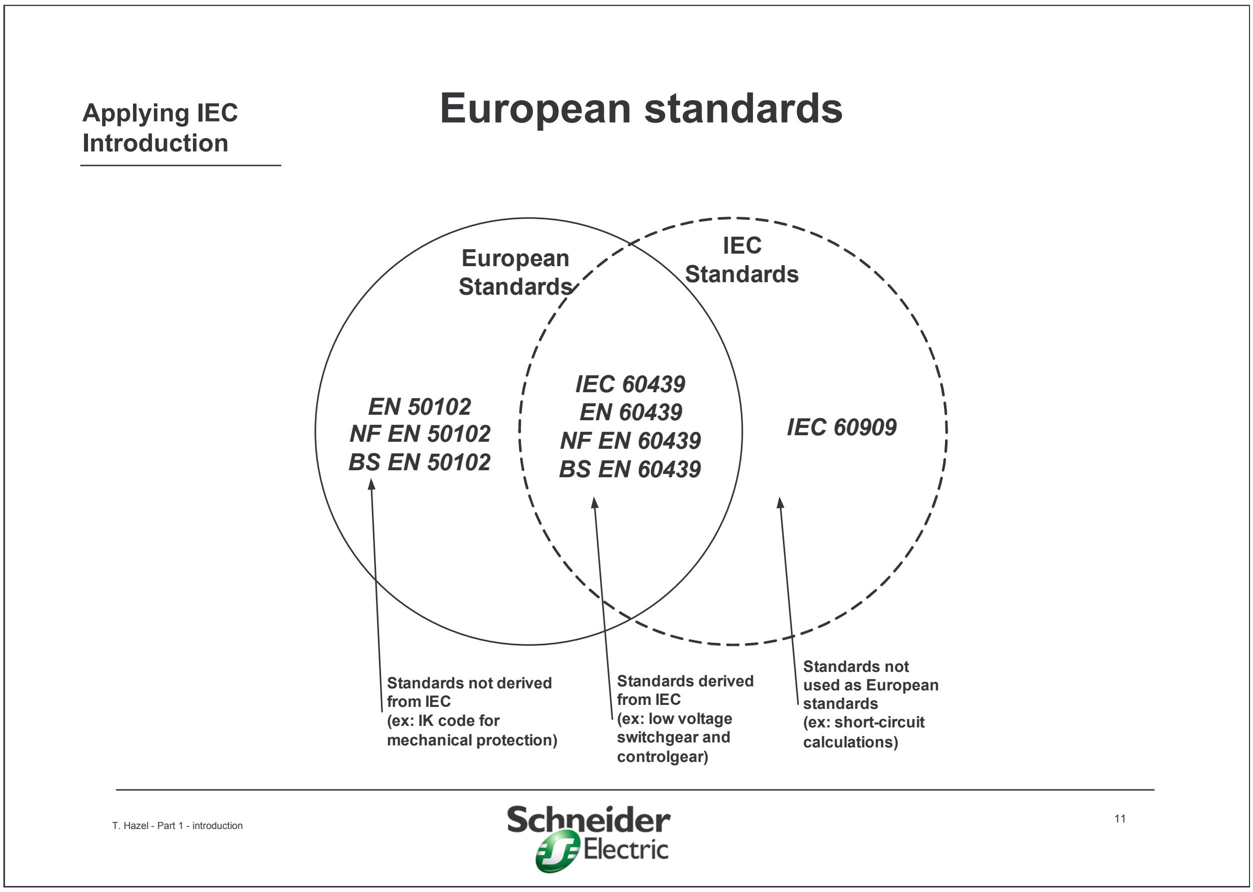
State that the requirement based on IEC or IEEE or CSA etc. whichever is most stringent.

what is similar, what is different

Although some scientists may doubt that electrical phenomena obey the same rules throughout the universe, there is no doubt that this is true in any electrical installation on earth. In addition the units used to measure electrical phenomena are fortunately the same in most systems of standards such as IEC, CSA, ANSI/IEEE. All electrical engineers are familiar with W, kvar, A, V, and kWh. The flow of reactive power is always positive into inductive loads. The direction of current is always the flow of positive charge.

There are however different ways of describing similar concepts. As an example IEC standards differ in their definition of rated power of transformers. In a discussion about the difference between the natural and forced cooling power of a transformer one engineer said it was 33% and the other disagreed saying it was 25%. Both were talking about 15/20 MVA and both were right. 20 MVA is 33% more than 15 MVA but 15 MVA is 25% less than 20 MVA. It depends on your point of view.

Remember: "You get what you specify, not what you want."



Applying IEC
Introduction

European standards

European Standards

IEC Standards

EN 50102
NF EN 50102
BS EN 50102

IEC 60439
EN 60439
NF EN 60439
BS EN 60439

IEC 60909

Standards not derived from IEC (ex: IK code for mechanical protection)

Standards derived from IEC (ex: low voltage switchgear and controlgear)

Standards not used as European standards (ex: short-circuit calculations)

Europe and the IEC

CENELEC and CEN

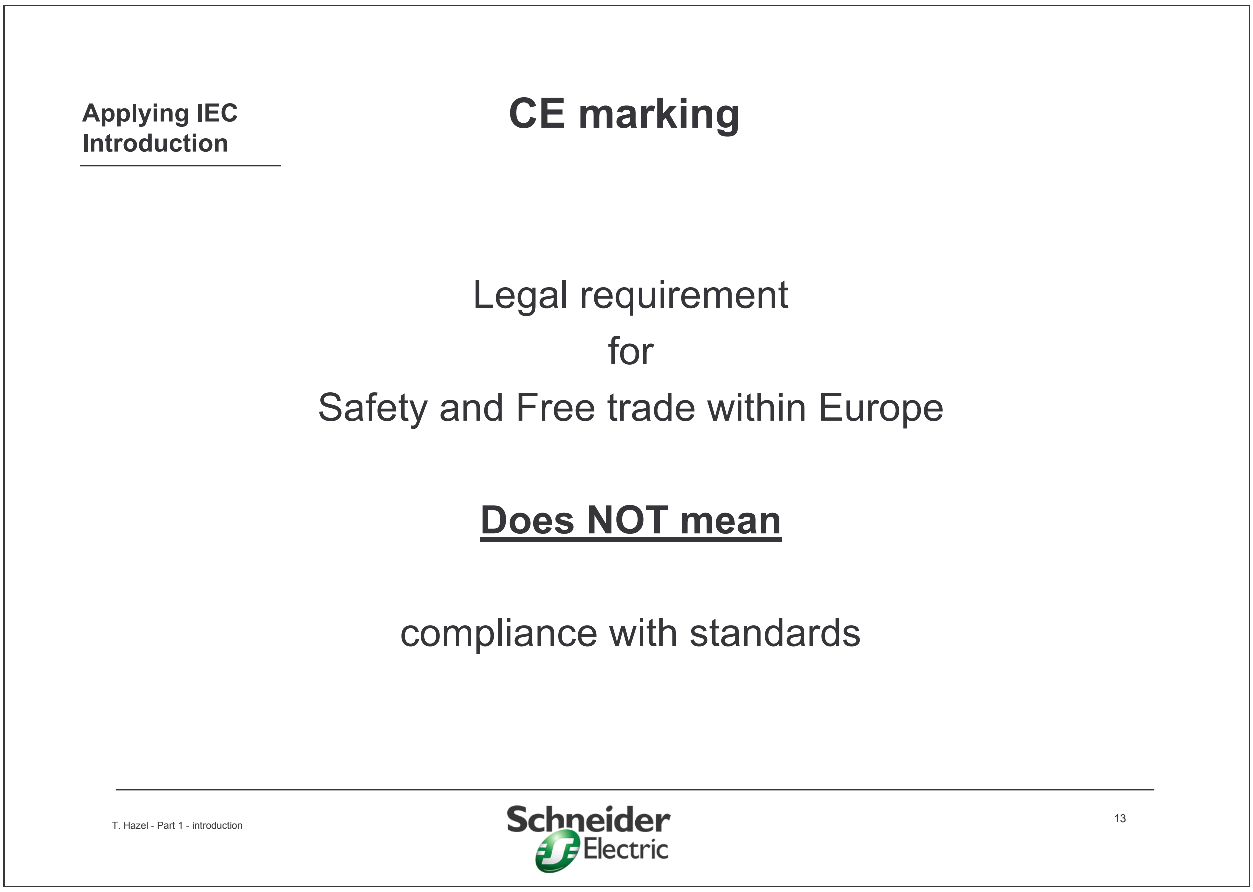
Europe has its own standards organizations called CEN (European Committee for Standardization) and CENELEC (European Committee for Standardization of Electrical Equipment). The same relationship exists between the CEN and CENELEC as between ISO and IEC. The reader is invited to consult the CENELEC website www.cenelec.be for further information.

When a member country of CENELEC desires to standardize something it firsts asks CENELEC if it wants to participate. If CENELEC wishes to participate the work will be done by CENELEC. If not the country making the request has permission to continue to work on the standard but as a national standard. This is similar to CENELEC requesting IEC to work on a standard. CENELEC can propose standardization work to the IEC. Any work done by the IEC will be voted on in parallel by CENELEC members to determine if the IEC standard should be accepted as a European standard as well.

European standards

When an IEC standard has been accepted by CENELEC member countries, a European standard is created. This standard has the same number as the original IEC standard and has the prefix EN (European Standard). In accordance with European regulations each member-country's national standard must be an exact translation of the related European standard in order to prevent national standards from hindering trade within Europe. The national standard also often has a number identical to the European Standard number, prefixed by the name of the national standards organization (NF for France, BS for Britain, etc). Compliance with the original IEC standard generally means compliance with the related European standard (if it exists) and therefore also with the related national standard. European standards do not necessarily have an IEC equivalent. An example of this is the European standard EN50102 defining protection provided by enclosures against mechanical impacts.

In addition to European standards there are also harmonization documents (HD). These are very similar to European standards in their form and contents but differ in their application. Harmonization documents often deal with such matters as installation of equipment where there is no need for European standards since trade is not an issue. The harmonization document will however define such aspects as safety rules which should be followed in all countries in accordance with the national laws.



Applying IEC
Introduction

CE marking

Legal requirement
for
Safety and Free trade within Europe

Does NOT mean

compliance with standards

European directives and CE marking

European directives are incorporated into regulations in the member countries. The basic principle of European directives is to ensure safety and facilitate trade within Europe. Examples of areas covered by European directives are:

☐ toys
☐ low-voltage equipment
☐ electromagnetic compatibility for consumer goods
☐ pressure vessels
☐ machinery

CE marking is obligatory in Europe for selling any products covered by a European directive. Compliance with the European directive is the responsibility of the manufacturer. In general compliance with applicable European standards is sufficient for compliance with the European directive. Compliance with the European directive does not necessarily mean compliance with European standards. Third party testing is normally not required.

CE marking should not be referred to in technical specifications to define equipment. Reference should always be made to standards.